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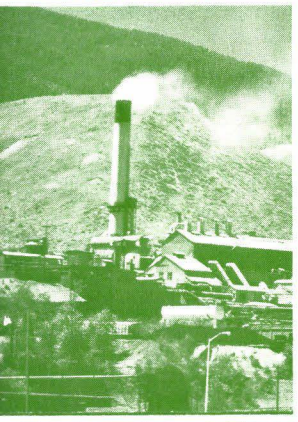

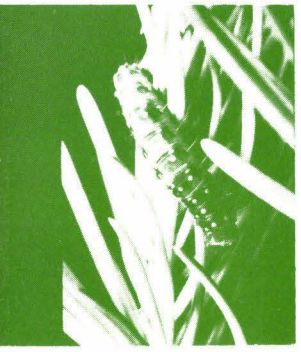

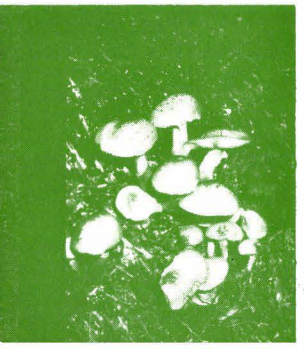

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EVALUATION OF THE MOUNTAIN PINE BEETLE INFESTATION BLACKFEET INDIAN RESERVATION AND EAST SIDE GLACIER NATIONAL PARK (MONTANA, 1979)

by

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ABSTRACT

Mountain pine beetle infestation was detected in stands on the east side of Glacier National Park and the adjacent Blackfeet Indian Reservation in 1979. Infestation in the Park now encompasses an estimated 215,882 acres. About 200 acres are infested on the reservation. In areas sampled, number of trees killed per acre increased from 2.3 trees in 1977 to 18.9 in 1979. Predicted mortality, plus management alternatives to prevent or reduce infestation severity, is discussed.

INTRODUCTION

Mountain pine beetle epidemics are the most severe insect problem in lodgepole pine forests in the West 1/. In relation to specific areas affected, where and when mountain pine beetle epidemics do occur, they overshadow all other mortality factors in lodgepole pine. Generally more than 90 percent of the lodgepole pine type in the West is ultimately susceptible to beetle epidemics, and when infested, 50 percent or more of the standing volume can be killed.

1/ Western Forest Insect Issues Study, Washington Office Report, USDA-Forest Service, 1978.

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Periodic epidemics have probably occurred as long as the beetle and lodgepole pine have shared a common habitat. Infestations have been recorded in lodgepole pine stands in the Region since 1909.

Of the more recent infestations occurring in the Northern Region, the most severe area of tree mortality is on the Flathead National Forest and in Glacier National Park, Montana. This infestation developed to epidemic status in 1972 and has increased rapidly since. In Glacier National Park, infested acreage increased from 1,180 acres in 1972, to 215,882 acres in 1979. In 1975, infestation spread into susceptible lodgepole pine stands on the Glacier View Ranger District (McGregor, Hamel, and Kohler 1978). Infested area increased from 80 acres in 1975, to 84,356 acres in 1979 (table 1). This infestation developed from local broods augmented by beetles from within the Park.

Table 1.--Acreage infested by mountain pine beetle - Glacier National Park and Glacier View Ranger District, Flathead National Forest, Montana, 1979.

	Glacier National Park		Glacier View Ranger District	
Year	Acres	Increase ratio	Acres	Increase ratio
1972	1,180	-	-	-
1973	3,600	1:3.0	-	-
1974	4,630	1:1.2	-	-
1975	13,354	1:2.8	80	-
1976	103,887	1:7.7	1,213	1:15.1
1977	142,871	1:1.3	27,610	1:22.7
1978	164,492	1:1.1	78,500	1:2.8
1979	215,882	1:1.3	84,356	1:1.0

In Glacier National Park, infestation continued to subside in areas between Logging and Quartz Ridges where the outbreak began in 1972. As preferred trees (≥8 inches dbh with thick phloem in many of the trees; ≥80 years old) are killed, infestation will continue to decline in stands infested 5-8 years. As this occurs, beetles will continue to immigrate into stands where lodgepole pine is of sufficient age, size, and phloem thickness to sustain an epidemic, such as those lodgepole pine stands on the east side of Glacier National Park and on the adjacent Blackfeet Indian Reservation. Infestations were detected in these areas for the first time in 1979.

On the east side of the Park, thousands of trees were killed from Boundary Creek drainage east to Waterton Lake, south throughout Waterton Valley, to Waterton and Kootenai Creeks and in the Mokowanis and Belly

River drainages north to the Canadian border. Groups of faders ranging from 3 to 500 trees per group occurred around Swiftcurrent Lake and Lake Sherburne, and new groups containing 2-150 trees per group occurred on the north side of St. Mary's Lake.

About 200 acres are infested on the Blackfeet Indian Reservation. All groups of faders were small, ranging from 2 to 100 trees per spot, from the south end of Lower St. Mary's Lake north to the Canadian border. Most groups occurred from Otatso Creek north throughout tributaries of Lee Creek.

Bureau of Indian Affairs officials, Browning, Montana, requested an evaluation be conducted to determine status, buildup ratio, and potential for future damage.

SURVEY METHODS

To obtain an estimation of trees killed by year and the remaining green trees, plots were established in four locations (figure 1). At each location, 10 variable plots (BAF 10) were laid out at 5- by 5-chain spacing. At each plot sample trees were selected with a relaskop or 10-factor prism. All live trees, regardless of species, and all dead trees, along with their appropriate damage classification, were tallied by diameter class. Heights of the first two trees of each species were measured for volume estimates. In addition, regeneration data were recorded from 1/300-acre plots at each variable plot center. Data were analyzed using the computer program INDIDS (Bousfield 1977) and used to predict future damage.

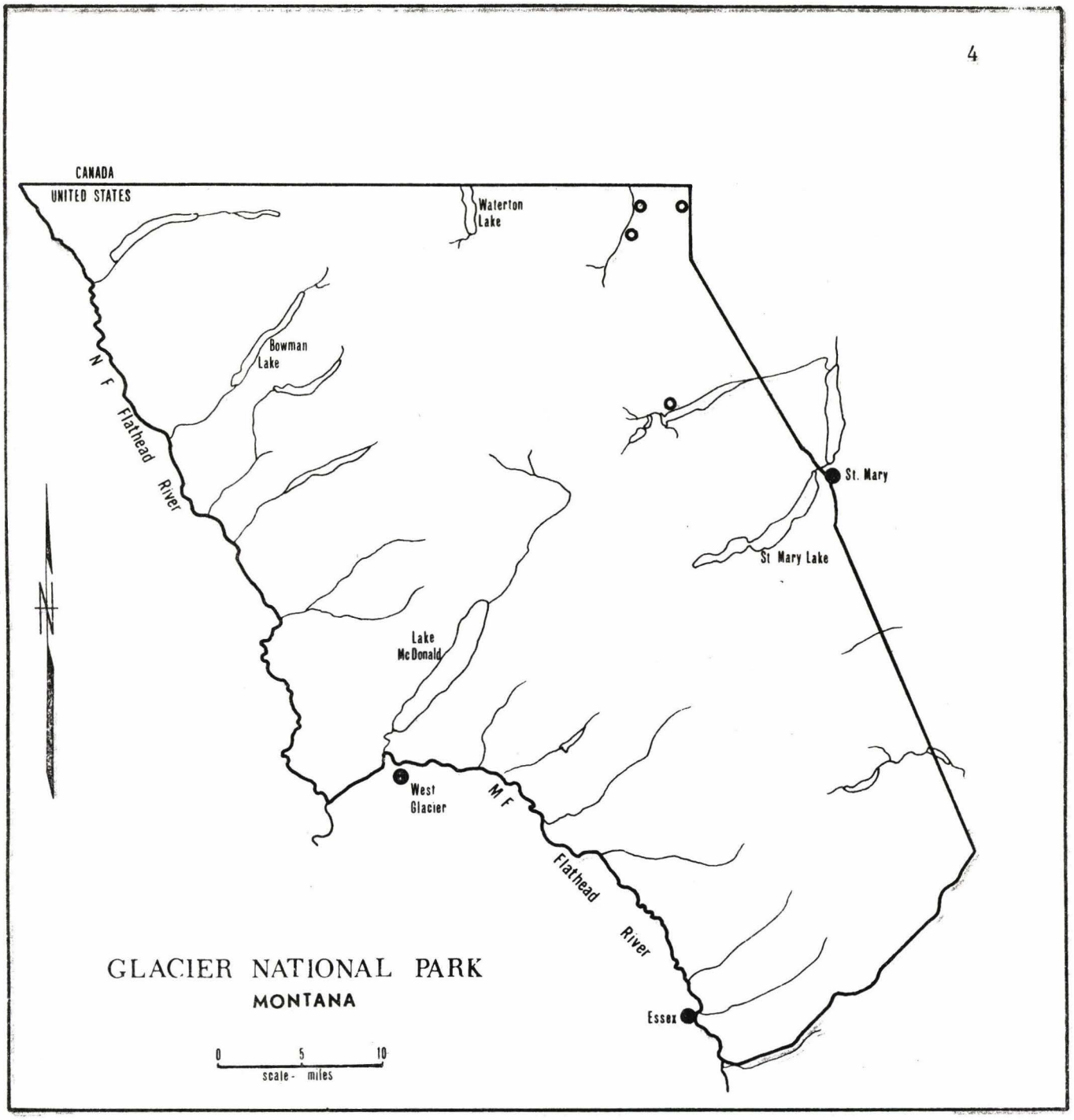

Figure 1.--Mountain pine beetle plot location, East Side, Glacier National Park, 1979.

RESULTS

Tables 2-4 contain data obtained from plots in Lee, Chief Mountain, Many Glacier, and the Belly River drainage. In 1979, 18.9 trees per acre containing 853.3 board feet per acre, were killed; 17.4 trees per acre containing 658.3 board feet per acre in 1978; and 2.3 trees per acre representing 71.1 board feet per acre in 1977. A total of 56 trees per acre have been killed to date. Of the merchantable volume (trees >5 inch dbh), 286.8 trees per acre remain containing 102 BA per acre.

About 5 percent of the total trees have been killed in these infested areas (14 percent of the total BA). Only 8 percent of the lodgepole pine have been killed (16 percent of the lodgepole pine BA). Lodgepole pine comprises 59 percent of the remaining green stand. Based on the available numbers of lodgepole pine, sufficient host material is available to sustain an epidemic infestation for several years.

Table 2.--Accumulative mountain pine beetle mortality in lodgepole pine on the Blackfeet Indian Reservation, and East Side Glacier National Park Montana, 1977-1979.

	1977	1978	1979	Total
Trees/acre	2.3	17.4	18.9	56.0
Basal/acre	1.0	8.7	11.0	20.7
Board ft/acre	71.1	658.3	853.3	1,582.7

Table 3.--Mountain pine beetle mortality by diameter class in infested stands on the Blackfeet Indian Reservation, and East Side Glacier National Park, Montana, 1977-1979. (All figures in trees/acre).

Diameter class (inches)	Trees killed/diameter classes 1977	1978	1979	No. green LPP/acre
1-4.9	0	0	0	78.8
5-11.5	9.2	61.0	55.2	277.3
> 12	0	8.6	12.1	9.5
TOTAL	9.2	69.6	67.3	365.6

Table 4.--Remaining green stand all species on the Blackfeet Indian Reservation and East Side Glacier National Park, Montana, 1979. (All figures in trees/acre).

Diameter class (inches)	Lodgepole pine	Subalpine fir	Spruce	Aspen	Douglas-fir
1-4.9	78.8	0	15.0	217.0	0
5-11.9	277.3	0.8	7.7	9.2	0
> 12	9.5	0	2.6	0.1	0.2
Total	365.6	0.8	25.3	226.3	0.2

DISCUSSION

Mountain pine beetle populations have increased at an alarming rate in the Northern Region since 1969. Even more spectacular is the amount of tree mortality that has occurred since 1972 in Glacier National Park and in the North Fork Flathead River drainage. The infested acreage increased at about a 1:2.6 ratio per year from 1972 through 1979 (figure 2).

Infestation as observed on the east side of the Park and on the Blackfeet Indian Reservation is typical of newly developing outbreaks (figure 3). With a plentiful food supply, infested acreage can more than double yearly, and small groups of faders will soon coalesce (within 3-5 years) and appear as shown in figure 4.

Baker (1968) developed a method for predicting lodgepole pine mortality during infestations. This is determined using a "buildup ratio" of current year's to previous year's mortality. His formula for predicting mortality is:

$Y^1 = y + bx$, where:

Y^1 = predicted mortality through next year (1980)

y = trees killed through current year (1979)

b = buildup ratio (x/x_1)

x = trees killed current year (1979)

Note: all figures are in trees per acre

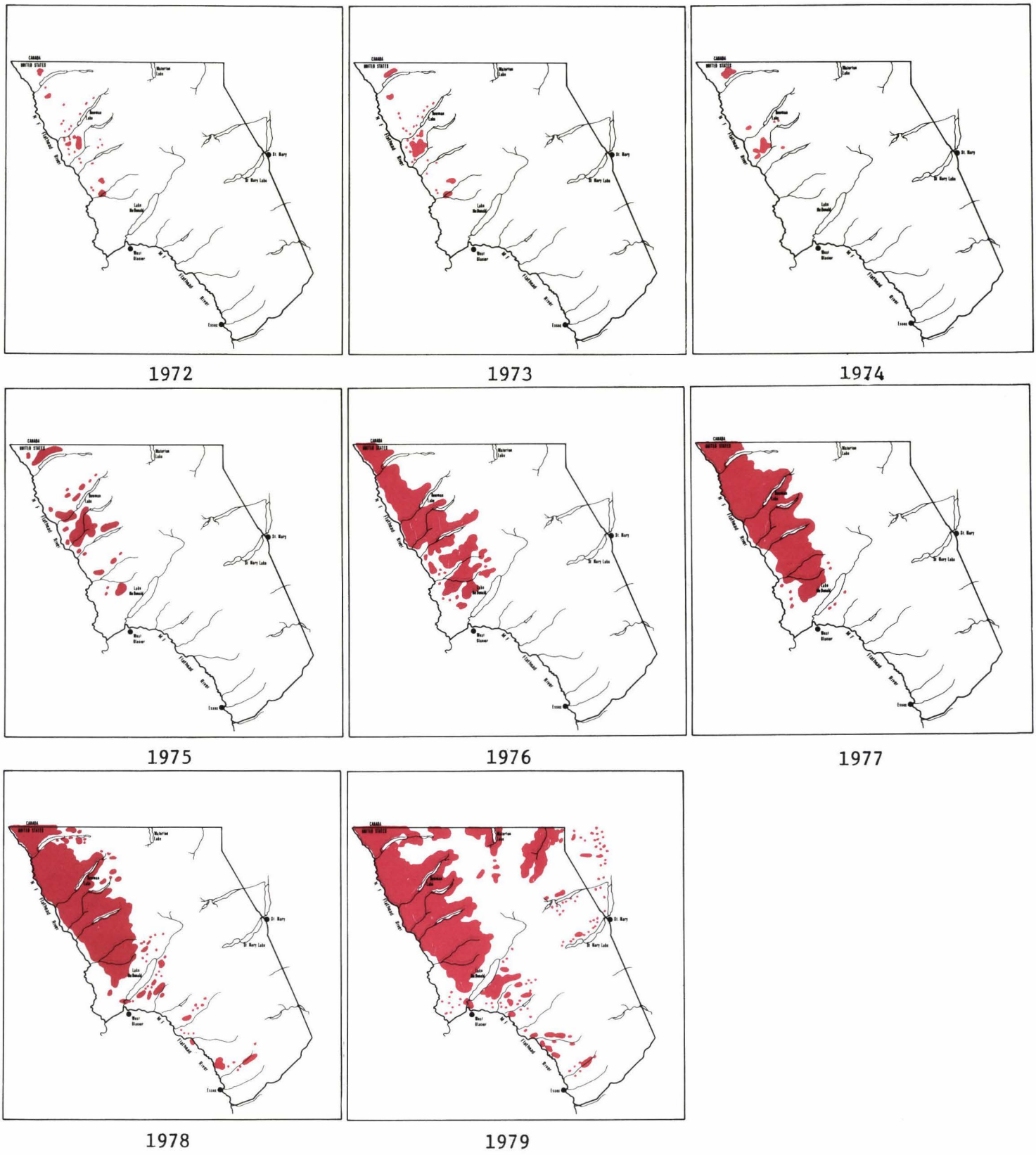

Figure 2.--Chronology of mountain pine beetle infestations, Glacier National Park and Blackfeet Indian Reservation, Montana, 1972-1979.

Figure 3.--Mountain pine beetle infestation, early stages of development, Blackfeet Indian Reservation and East Side Glacier National Park, MT, 1979.

Figure 4.--Mountain pine beetle epidemic 5 years after initial infestation, West Side Glacier National Park, 1979.

An application of Baker's formula to mortality figures shown in table 2 indicates the potential for mortality in 1980 of more than 18 trees per acre.

Buildup ratio (b) = x/x, - 18.9/17.4 = 1.0

Potential mortality in 1980 (bx) - 18.9 (1.0) = 18.9

Potential accumulative mortality through next year (y^1) = 56.0 + 18.9 = 75.9 trees/acre

Although these figures are low compared to infestation in other locations in the Park, tree mortality has exceeded that in most areas since the outbreak began in 1972. Also, with beetles augmenting inplace population buildup, the infestation is expected to expand rapidly on the east portion of the Park and on the reservation.

Safranyik 2/ identified six criteria for determining the probability of beetle immigration into infested areas, which are:

1. Historic evidence of beetle activity in surrounding areas.

2. Recent beetle activity--within the past 3-5 years. Are beetle populations in surrounding areas building?

3. Stand parameters in the uninfested area. Are trees of a susceptible age and size class, and does the stand have a high percentage of host species?

4. Large continuous areas of high-hazard, uninfested trees.

5. Major outbreaks near the uninfested area. There is much evidence to show that beetle populations do immigrate into, as well as develop in, a given stand.

6. Relationship of elevation and latitude.

Many of these same criteria have been incorporated into a hazard rating system developed by Amman et al. (1977). Their criteria for a high-hazard lodgepole pine stand are:

1. Average stand age >80 years.
2. Average stand diameter >8 inches dbh.
3. Elevation less than 6,000 feet (at 48° N. latitude).

2/ Safranyik, L., Research Entomologist, Pacific Forest Research Centre, Victoria, B.C., 1979, personal communication.

These factors illustrate why the beetle has increased so rapidly in Glacier National Park. They further provide evidence for our prediction that beetle populations will continue to increase until most of the susceptible lodgepole pine has been killed in those stands--probably within the next 3 to 5 years.

Management Alternatives

Within the past several years much valuable information has been obtained concerning manipulation of mountain pine beetle populations through appropriate stand management. Cole (1978) and Amman et al. (1977) have stated that infested and high-risk stands can be managed in several ways depending upon land use objectives and stand composition. Where extensive stands contain large-diameter and older-age trees (high risk), they can be broken up by small organized clearcuts. This helps eliminate stands which are conducive to large population buildups of the beetle. Where smaller stands are, or approach, high-risk, they can be completely removed.

Cole (1978) has summarized feasible silvicultural practices for stands where composition is pure lodgepole pine and form is even-aged:

1. Stocking control in young stands.

2. Organized clearcutting in blocks to create age, size, and species mosaics from mature stands.

3. Salvage or partial cuts.

4. Salvage cutting to reduce mortality in stands under attack.

In uneven-aged pure lodgepole pine and mixed species stands, the preventive practices mentioned for pure, even-aged lodgepole pine stands are also feasible (Cole 1978). In mature mixed species stands with large lodgepole pine in the overstory, block clearcutting is recommended as a preventive to develop a mosaic pattern. If already attacked, mortality can be reduced by salvage cutting. Selective cutting to remove overstory lodgepole pine is recommended provided the residual trees are the desired species, age, and stocking level. If immature, such stands are candidates for stocking control, with species discrimination possible while reducing stand density in mixed species stands.

Discrimination against lodgepole pine is possible in older mixed stands through partial cuts in which only the most susceptible lodgepole pine portion of the main stand is removed (Cole 1978).

Partial cutting has been shown an effective treatment to reduce potential mortality in susceptible stands (Hamel and McGregor 1976; Cole and Cahill 1976; Hamel 1978). Where timber values are primary, partial cuts for beetle management may only be appropriate where a small proportion of the trees are high-risk lodgepole and where enough residual trees remain to maintain productivity (Amman 1976). Alexander (1975) cautions that lodgepole stands partially opened may be more susceptible to windthrow, dwarf mistletoe, and logging damage. He states that from a silvicultural viewpoint, partial cuts are the only option managers have where (1) multiple-use considerations preclude clearcutting, (2) combinations of cleared openings and high forest are required to meet forest management uses, and (3) regeneration of the stand is difficult after clearcutting.

Data (unpublished) from the Lolo National Forest show that selective cutting--removing some large as well as small diameter trees--has prevented and reduced beetle attack along visual areas such as roads, streams, etc. This will also lessen the siltation impact to stream channels which could be created by clearcutting. Partial cutting, whether selectively leaving large and small diameter lodgepole pine, or a straight commercial thinning based on tree diameter regardless of crown, has prevented and/or reduced incidence of beetle attack in stands on the Plains Ranger District, Lolo National Forest. Finally, partial cutting can be applied as a last resort to after-the-fact salvage of beetle-killed trees. An increased utilization of sound material and a degree of direct control of beetle populations by removing beetle-infested trees would buy time to accomplish preferred block cutting (McGregor et al. 1978).

One additional management alternative exists for those stands where single-tree esthetic values are primary. In campgrounds, summer home areas, or around administrative sites, high-value trees can be successfully protected from mountain pine beetle attack through the use of a preventive spray. Sevimol-4®, a water-soluble mixture of carbaryl insecticide in a molasses carrier, applied prior to beetle flight has proven to be a safe, economical, and highly efficient means of protecting individual trees (Gibson 1978).

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